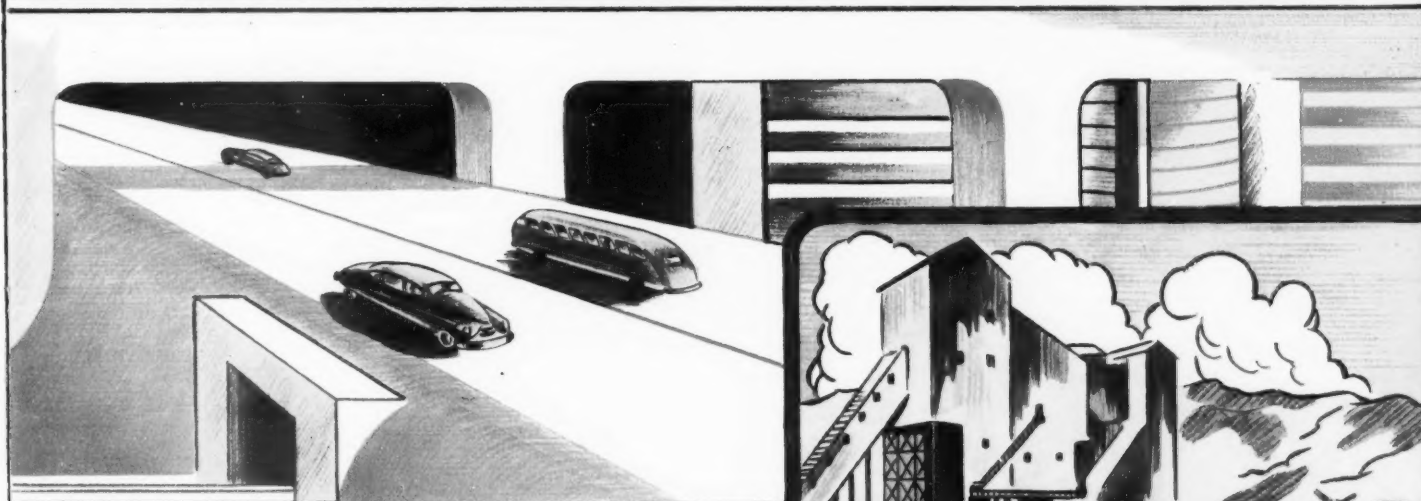
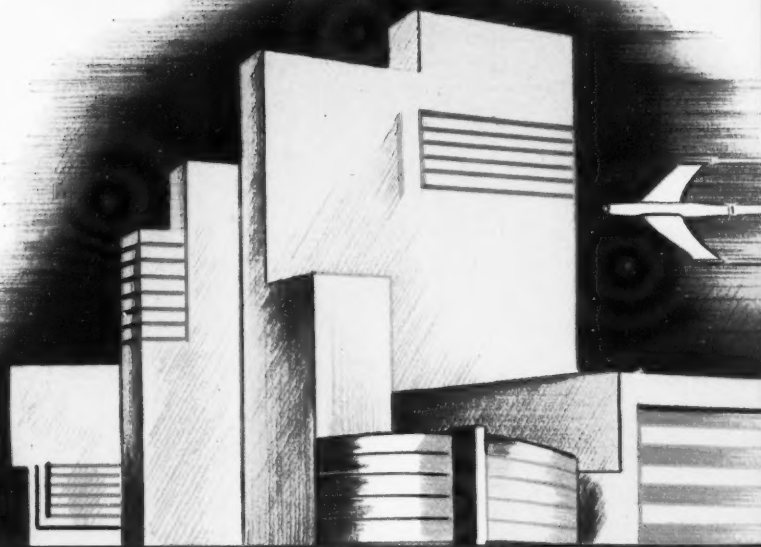


The CRUSHED STONE JOURNAL



PUBLISHED QUARTERLY

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December 1949

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- 5th Annual Convention of ALI to Be Interesting and Informative
- Do We Learn to Operate Safely from the Experience of Others?
- James M. Rice Joins NCSA Staff
- Status and Relative Progress of the Federal-Aid Highway Program

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The Crushed Stone Journal

Official Publication of the NATIONAL CRUSHED STONE ASSOCIATION

J. R. BOYD, Editor

NATIONAL CRUSHED
STONE ASSOCIATION



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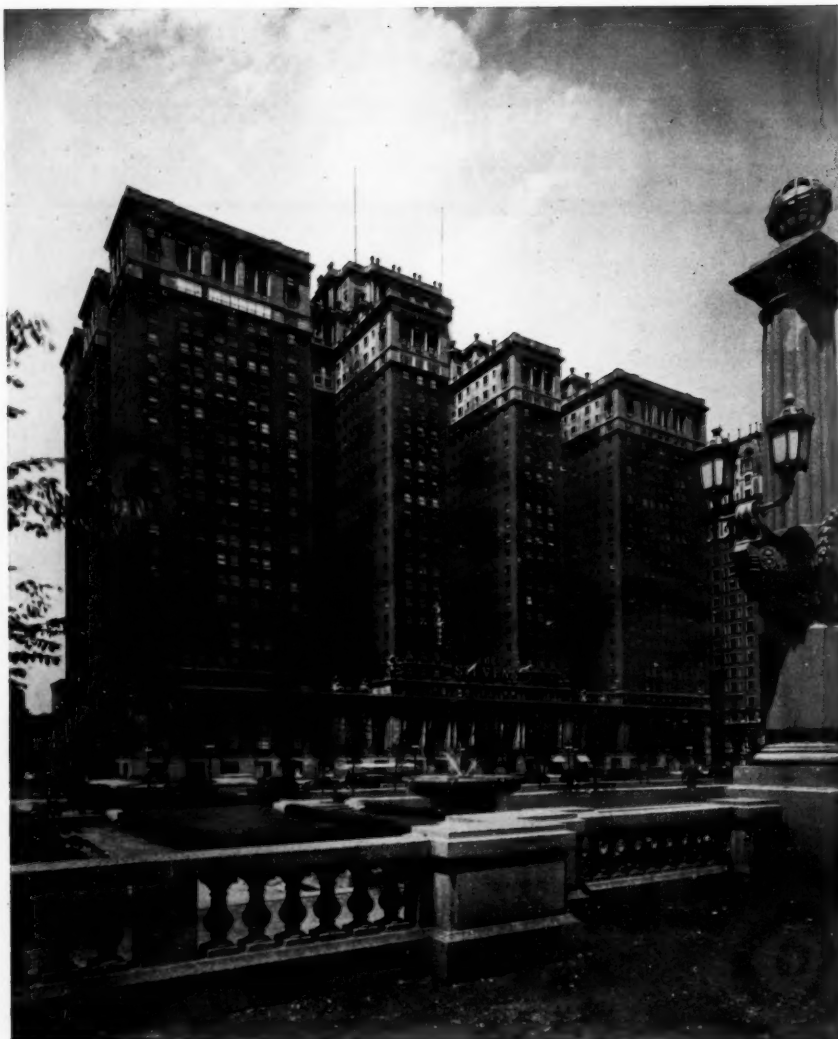
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*The
Stevens*
CHICAGO

33rd ANNUAL CONVENTION
NATIONAL CRUSHED STONE ASSOCIATION
January 30, 31, February 1, 1950

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5th ANNUAL CONVENTION
AGRICULTURAL LIMESTONE INSTITUTE
February 1, 2, 3, 1950

THE CRUSHED STONE JOURNAL

WASHINGTON, D. C.

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DECEMBER 1949

Plans for 33rd Annual Convention of NCSA Near Completion

Exposition to be Largest Ever Held

WITH plans rapidly nearing completion for the 33rd Annual Convention of the National Crushed Stone Association, to be held at The Stevens, Chicago, on January 30, 31, and February 1, 1950, this traditional event for crushed stone producers promises to exceed all past efforts in providing those engaged in the crushed stone industry with the opportunity to hear outstanding speakers discuss a wide variety of subjects of vital importance to the efficient and profitable conduct of their businesses.

Executives, salesmen, operating men, and the manufacturers of equipment, all, will find much of real value on the excellent program which has been most carefully developed by the Convention Arrangements Committee under the capable chairmanship of Otho M. Graves.

The Manufacturers Division Exposition alone should be sufficient incentive to bring all producers to Chicago to view first-hand the many exhibits of machinery and equipment which will be displayed on a tremendous scale. More than twice as much space will be occupied by a larger number of exhibitors than at any of our previous expositions.

The ladies will be especially welcome in Chicago and for their particular pleasure and enjoyment a program of unusual interest has been arranged.

While the complete convention program will be released shortly, for your advance information some of the highlights of the three-day meeting are described briefly in the following.

Program Features

At the opening session on Monday morning, President Weston will make a report on business condi-

tions during 1949 and the outlook for 1950, based on information submitted to him by the Regional Vice Presidents. Reports from the Executive Staff will then be received, following which the feature address of the morning will be made by Leland Stowe, European Editor of *The Reporter Magazine*, entitled "Billions of Dollars—And a Lot More Sense." Those who were present at the annual meeting in New York last year will recall the deep impression made by Mr. Stowe when he talked to us at that time and we are especially privileged to have him for a return engagement. Mr. Stowe recently spent some four months in Western Europe studying and analyzing the situation there, particularly with respect to the Marshall Plan. He comes to us, therefore, exceptionally well informed on a subject of the most vital concern to every American citizen.

For the Greeting Luncheon on Monday we will have as the guest speaker, Dr. Kenneth McFarland, Superintendent of Schools, Topeka, Kansas. While nationally recognized as a brilliant school executive, Dr. McFarland is best known as an outstanding public speaker, it being commonly acknowledged that he has few peers in this field. In addition to being retained by General Motors as a public speaker, Dr. McFarland was the one man selected from the entire nation to serve as a guest lecturer for *Reader's Digest*. The subject of his talk to us will be "The 'U' in Business."

The afternoon session will open with A. C. Leonard, Chief, Secondary Roads Branch, Bureau of Public Roads, speaking on "The Secondary Road Program," and we hardly need emphasize the vital importance of this subject to the industry.

Next on the program will be our good friend, John C. Gall, who will bring us up to date on federal legislation affecting management-labor relationships and also as to recent developments with respect to selling on a delivered price basis.

Delegates to the convention will be entertained on Monday evening by a cocktail party and a buffet dinner, following which there will be a formal inspection of the Manufacturers Division Exposition for everyone present.

The annual business meeting of the Association will open the session on Tuesday morning, concluding with the report of the Nominating Committee and the election of officers and members of the Board of Directors for the ensuing year.

As the first feature speaker of the morning, Kenneth B. Woods, Professor of Highway Engineering and Associate Director, Joint Highway Research Project of Purdue University, will discuss "Aggregates and Their Influence on the Durability of Concrete." His work with the Joint Highway Research Project gives Professor Woods an exceptionally fine background for his talk on durability and we can be sure of receiving from him interesting and extremely helpful information.

In his own self-interest, the American businessman today must keep reasonably well informed concerning developments in foreign affairs, both politically and economically, for such developments inescapably have a profound effect upon our own internal economy. We are most fortunate in being able to schedule for the concluding talk on Tuesday morning, "Report on Russia Today," by Robert Magidoff, former Moscow correspondent for the National Broadcasting Company. Mr. Magidoff, as many of you will recall, is author of the current book "In Anger and Pity," and for twelve years was correspondent in the Soviet Union, receiving wide-spread publicity in America when he was summarily expelled from Russia in April 1948. He is without doubt one of the best informed men in the country on the Russian problem and should make a highly interesting contribution to the convention program.

The luncheon on Tuesday is for members of the Manufacturers Division only, as it is at that time that they hold their annual business meeting, including the election of officers.

The opening talk on Tuesday afternoon will be entitled "Keeping Ahead of the Headlines," and will be presented by Frederic Snyder, New York newsman and publicist of Kingston, N. Y. Mr. Snyder applies the ability of a skilled journalist in the preparation

of his lively and appealing talk. His address is made up like a newspaper, including some sensational headline facts, an inspiring editorial, a humorous column, and some advertisements urging action. He is a man who has imagination, a vivid vocabulary, and a keen sense of humor. Here is something different and thoroughly enjoyable.

Failure of many states to match federal-aid allocations emphasizes the growing need of educating the public to the inadequacy of the present highway system. Definite action in this regard has been undertaken in New York State with the formation of the New York Good Roads Association and the employment of C. H. Sells as Executive Director. It will be recalled that Mr. Sells was formerly Superintendent of the New York State Department of Public Works. He will address the Tuesday afternoon session on the subject "Developing Public Demand for Good Roads." Under the able guidance of Mr. Sells, the New York Good Roads Association has been aggressively developing public demand for good roads and his experience and knowledge in this field should prove decidedly helpful to those in other states desiring to follow a similar course of action.

The afternoon session will be concluded with a paper entitled "More Durable Asphaltic Concrete Pavements," and will be presented by Raymond Harsch, Manager, Asphalt Department, Shell Oil Company, San Francisco, California. Mr. Harsch has served the Shell Oil Company in his present capacity since 1944. Because of his earlier training as Materials Engineer for District 12 of the Bureau of Public Roads and later as Materials Engineer for the Idaho Bureau of Highways, coupled with his extensive experience with the Shell Oil Company since 1930, Mr. Harsch is especially well qualified to contribute a paper of real interest and value in the field of asphaltic concrete pavement construction.

On Tuesday evening, those interested in accident prevention will gather informally for the exchange of information in connection with the prevention of accidents in the crushed stone industry, with F. J. Buffington, Chairman of the NCSA Accident Prevention Committee, presiding.

NCSA and ALI Hold Joint Events on Wednesday

The 5th Annual Convention of the Agricultural Limestone Institute will be held on February 1, 2, and 3, at the same hotel with Wednesday, February 1, devoted to joint events. In the morning, NCSA and ALI will join in a session for operating men and

equipment manufacturers. The highlight of which will be a panel discussion of operating problems to include the following basic questions:

1. What are the best methods of producing and screening minus 1/4-in. sizes?
2. What are the relative merits of various drilling methods?
3. What are the most effective means of reducing the percentage of flat and elongated pieces?
4. What are the relative merits of unit trucks and tractor-trailer trucks for haulage of rock from quarry face to plant?
5. What are the most effective methods of dust control?

The session will be presided over jointly by G. D. Lott, Jr., Vice President, Palmetto Quarries Company, Columbia, S. C., and Marvin Nelson, Concrete Materials and Construction Company, Cedar Rapids, Iowa, with the following particularly well-informed operating men constituting the panel: F. H. Edwards, New Haven Trap Rock Company, New Haven, Conn.; E. F. Haberkern, Columbia Quarry Company, St. Louis, Mo.; W. H. Ruby, Acme Limestone Company, Fort Spring, W. Va.; and Nelson Severinghaus, Consolidated Quarries Corporation, Decatur, Ga.

There will be a joint luncheon on Wednesday for all attending both the NCSA and ALI conventions, with a luncheon address entitled "What's Ahead for the USA?" This subject will be handled by Merryle Stanley Rukeyser, Economic Commentator for International News Service, author, and one-time member of the teaching staff of Columbia University. Mr. Rukeyser is a dynamic force for straight thinking and for sound economic doctrine, a staunch and effective defender of the American way of life. Those who have the privilege of hearing him will certainly profit from his analysis of what lies ahead.

On Wednesday afternoon there will be a joint inspection by NCSA and ALI of the Manufacturers Division Exposition. It bears repeating that this Exposition will by all odds be the most comprehensive ever held and the opportunity of viewing latest developments in machinery and equipment and talking directly to the technical representatives of exhibitors should be utilized to the fullest extent by all attending the convention. Remember, the Exposition now is held only every other year with the next one not scheduled until 1952.

There will be a special session for salesmen on Wednesday afternoon, which will open with a talk entitled, "Salesmanship—A Lost Art," by O. J. McClure of Chicago. Following Mr. McClure's presentation the meeting will be open for a general discussion of sales problems. Mr. McClure thoroughly understands the psychology of selling and has the happy faculty of presenting his ideas and thoughts in a common sense and understanding manner. All salesmen of NCSA and ALI are invited to attend this joint session on selling, from which they are certain to get many practical and useful ideas.

On Wednesday evening, NCSA and ALI will join for their annual banquets, which will be preceded by a joint cocktail party for all in attendance at the convention. The banquet address will be given by Edward McFaul and his subject has the intriguing title "So You Think You're Slipping." Mr. McFaul, formerly a member of the faculty of Northwestern University, is today considered one of the nation's most popular after-dinner speakers. His tantalizing, penetrating, and smile provoking humor entertains while it instructs. To hear Mr. McFaul is certain to be an exhilarating experience.

Make Your Hotel Reservations Immediately

While The Stevens is known as the largest hotel in the world, it is nevertheless advisable in order to obtain the type of accommodations desired to make reservations in advance. The Association will be glad to send upon request a special hotel reservation card which assures preferred treatment.

The annual convention of the Association serves many purposes. It brings together from all sections of the country those engaged in the same line of business for the mutual and helpful exchange of business experience. It provides the opportunity to hear highly qualified speakers discuss technological developments of great interest to the industry. Through the medium of the Exposition, you obtain first-hand information concerning the tools with which you have to work. It gives you directly from experts authoritative opinions as to important developments outside the field of your own operations; and last, but by no means least, you meet at the convention friends of many years' standing and develop new acquaintances which through the years ahead are certain to add to the fullness of life.

All crushed stone producers, whether or not members of the National Crushed Stone Association, are cordially invited to attend the convention and participate in its many benefits and pleasures.

5th Annual Convention of ALI to be Interesting and Informative Exposition Added Feature

BASED on advance hotel reservations and early general interest, the 5th Annual Convention of the Agricultural Limestone Institute promises to be outstandingly successful. It will be held at The Stevens in Chicago, on February 1, 2, and 3, 1950, at the same hotel and during the same week as the 33rd Annual Convention of the National Crushed Stone Association.

It is most fitting that these two associations—representing the crushed stone and agricultural limestone industries—should meet together for their forthcoming annual conventions at a time when the associate members of both groups (the manufacturers of machinery, equipment, and supplies) will stage the biggest and best Exposition of their products that has ever been presented for the inspection of stone producers. It should be a “must” for every producer of agricultural limestone to examine these exhibits most carefully.

Joint Sessions on Operating and Selling Problems

The holding of these two annual meetings during the same week affords another golden opportunity—that of holding joint sessions on the problems of operating stone plants and on the selling of the finished products, previously outlined on page 5.

A Varied and Interesting Program

Thursday, February 2, will be devoted to subjects of particular interest to members of the agricultural limestone industry. J. E. Lamar, an eminent geologist for the State of Illinois, will talk on “The Geology of Limestones”—a topic which will be of real interest to everyone. Maurice Lockwood will tell about the close relationship of the fertilizer and limestone industries and suggest ways in which the two industries can go down the road together. How the Agricultural Conservation Program for 1950 will operate will be explained by Alvin V. McCormack, Director of the Agricultural Conservation Programs Branch of the Production and Marketing Administration, and R. H. Musser, of the Soil Conservation Service, will make an address entitled “Soil Conservation Pays Big Dividends.”

The Thursday afternoon session will close with a symposium on the promotion of agricultural lime-

stone. A number of the state associations have been carrying on promotional programs—each one differing from the others—and the reports of their activities will prove to be interesting and laden with valuable information. The following persons have agreed to make reports on the promotional work carried on in their states:

H. H. Wagner, Secretary, Agricultural Limestone Division, Pennsylvania Stone Producers Association, Harrisburg, Pa.

W. E. Stone, President, The Processed Limestone Association, Inc., Piqua, Ohio.

Ralph E. Simpson, Engineer-Director, Indiana Mineral Aggregates Association, Inc., Indianapolis, Ind.

N. F. Schwarz, Secretary, Midwest Agricultural Limestone Institute, Decatur, Ill.

Paul N. Doll, Manager, Missouri Limestone Producers Association, Jefferson City, Mo.

Clint A. Allen, Executive Secretary, Iowa Agricultural Limestone Association, Inc., Des Moines, Iowa.

On Friday, February 3, there will be two talks by agronomists who are leaders in their field. F. V. Burcalow, University of Wisconsin, who has spent years on grassland problems, will talk on “Grassland Farming in Wisconsin.” George H. Enfield of Purdue University will summarize the years of research and field demonstration work on liming for field crops in Indiana.

Entertainment and Fun for All

The lighter side of life has not been overlooked in planning the convention program. NCSA and ALI jointly will hold a luncheon, reception, and banquet. These affairs are always very popular and a record-breaking attendance is anticipated. Also, by popular demand, on the night of February 2, ALI will have a cocktail party and buffet dinner. Those who attended this enjoyable social get-together last year will certainly not want to miss this one.

Make your plans now to attend this convention and bring your ladies with you. Special events are being arranged for their pleasure and entertainment. Send in your hotel reservation early so you will not be disappointed in getting the kind of accommodation you want.

Do We Learn to Operate Safely from the Experience of Others?¹

By FORREST T. MOYER

Chief, Accident Analysis Branch
Health and Safety Division, Bureau of Mines
U. S. Department of the Interior
Washington, D. C.

THE safety record of the quarrying and nonmetal-mining industries in 1948 showed definite improvement. The total of 6,263 injuries was a reduction of 9 per cent from 1947. The frequency rate, which is a more useful measure of safety performance, was lowered 12 1/2 per cent from 1947 to an occurrence of 30 injuries per million man-hours of worktime during 1948. This frequency of injuries in 1948 was lower than in any other year in a statistical history starting in 1930.

Some degree of improvement in the safety record was attained in 1948 by each major segment of the stone industries except marble quarrying. The improvement was sharp in the granite industry, in which the frequency rate of injuries was reduced one third from 1947. It also was outstanding in slate and sandstone operations, where the reductions were, respectively, 25 and 21 per cent. At limestone quarries, in the cement and lime industries, and in nonmetal mines the improvement in the frequency rate in 1948 was moderate and ranged between 8 and 10 per cent. Only a slight betterment of the record was noted for traprock operations. In marble quarrying, the frequency of injuries in 1948 was 7 per cent higher than in 1947; however, the 1948 rate was the third lowest annual rate in the last 10 years.

The improvement in the frequency rate for quarries and nonmetal mines is no reason to feel that the accident problem is licked. The fact remains that 6,263 men were injured during the year and that these injured men were part of an average working force of 90,400 men. It is startling to realize that 7 per cent of the men working at quarries and nonmetal mines were injured in some way. Furthermore, 88 of the injuries in 1948 were fatalities, a total that is virtually the same as the average annual number of fatalities during the past 10 years. These aspects of the safety record clearly show the need for more detailed analysis of accident elements and

for more intensive accident-prevention work in the stone industries.

Analysis of 477 injury reports received from the quarries and nonmetal mines enrolled in the 1948 National Safety Competition of the Bureau of Mines indicates that certain accident elements should have special attention. These elements merit special attention because control of them would result in a sizeable reduction in injuries.

Where Accidents Occurred

The injuries in the study comprised 9 fatalities, 30 permanent partial disabilities, and 438 temporary total disabilities. There were no permanent total disability cases. Of the 9 fatalities in the study, 4 occurred in the quarry, 2 in underground workings, 2 in surface work, and 1 at the crusher. When classified by location of occurrence, the injuries of the study were distributed as follows: 36 per cent were in the quarry, 21 per cent in underground workings, 27 per cent at surface works associated with a quarry or deep mine, and 17 per cent at the crusher. Injuries in cement mills and lime-calcining plants are excluded from the study. Unfortunately, the distribution of the injuries by location could not be related to any measure of exposure. Hence there is no way of comparing the occurrence of injuries by location in this study on a common basis such as the frequency rate. However, it is believed that the proportion of injuries in relation to general work and in the crusher department are both of unusually high proportions in relation to a general conception of the total volume of worktime in these departments.

Training Vital for New Employees

One of the first accident elements to be considered is the experience of the injured workers. Invariably an analysis of this element shows that new and inexperienced workers in the quarrying and nonmetal-mining industries suffer an unusually large proportion of the injuries. Of the injuries in this study, 20 per cent were incurred by men with 6 months or less experience and 12 per cent by men with more than 6 months but less than 1 year experience. The total of 32 per cent of the injuries in 1948 to men

¹ Presented at the meeting of the Cement and Quarry Section, National Safety Congress, Chicago, Ill., October 21-25, 1949

Number of Injuries in Quarries and Nonmetal Mines in the United States, 1939-48, by Type of Material ¹

Year	Cement		Limestone		Lime		Marble		Granite	
	Fatal	Nonfatal	Fatal	Nonfatal	Fatal	Nonfatal	Fatal	Nonfatal	Fatal	Nonfatal
1939	12	457	14	1,743	7	1,004	—	429	8	607
1940	15	521	21	1,953	12	1,056	3	242	12	543
1941	14	705	30	2,622	17	1,551	—	240	8	719
1942	46	787	30	2,530	12	1,342	2	171	14	531
1943	21	773	31	1,936	15	1,284	—	137	5	403
1944	15	637	29	1,596	14	1,050	1	102	6	385
1945	9	600	24	1,381	8	961	2	164	7	396
1946	12	834	26	1,878	4	1,011	—	173	5	493
1947	26	820	24	1,921	6	1,022	2	200	4	652
1948	24	800	28	1,735	9	995	1	185	6	500

	Traprock		Slate		Sandstone		Nonmetal mines		Total	
	Fatal	Nonfatal	Fatal	Nonfatal	Fatal	Nonfatal	Fatal	Nonfatal	Fatal	Nonfatal
1939	4	275	3	376	—	313	10	719	58	5,923
1940	3	269	1	355	5	249	14	826	86	6,014
1941	4	361	1	323	2	349	17	1,182	93	8,052
1942	5	334	2	334	1	320	20	1,270	132	7,619
1943	4	254	—	134	4	278	25	1,471	105	6,670
1944	3	228	3	146	2	293	17	1,283	90	5,720
1945	—	195	—	115	3	309	16	1,145	69	5,266
1946	3	221	2	181	3	346	26	1,369	81	6,506
1947	3	261	3	243	7	385	12	1,308	87	6,812
1948	1	260	3	195	1	340	15	1,165	88	6,175

¹ Data for 1948 are preliminary

with 1 year or less experience indicates the fertile field in which the plant manager and the safety engineer can work in reducing the number of accidents.

Cement Training Programs Ineffective

It is notable that men with 1 to 2 years experience had 16 per cent of the injuries in 1948. This is only half of the proportion of the total injuries suffered by men with less than 1 year experience. The remaining 52 per cent of the injuries in the study were to employees with more than 2 years experience in the industries.

The problem of educating inexperienced men in safe work procedures is a tough one. Perhaps this is the reason why little or no progress has been made in reducing their proportion of injuries. Similar studies in the two preceding years showed that in 1946, 31 per cent of the injuries in quarries and non-metal underground mines affected men with 6 months or less experience, and in 1947 these inex-

perienced men suffered 27 per cent of the injuries. It is questionable whether or not the reduction from 1946 to 1948 in the percentages of injuries to inexperienced men represents an improvement because the employment statistics on the industries indicate that the proportion of new employees entering the industries also decreased during the same successive years. It should be remembered that the problem of training new men is ever present in the operation of your quarries and mines.

A striking example of the effects of inexperienced employees on safety records was found in the quarries participating in the National Safety Competition. In the spring of 1948, a company (which, incidentally, is noted for its aggressive accident-prevention program) reopened a quarry that had been closed since in the early 1940's. It is assumed that most of the employees at this quarry would be inexperienced. In an operating time of 67,000 man-hours during the year 6 temporary total injuries oc-

curred. The frequency rate for the operation was 90 injuries per million man-hours, and the severity rate was 1.3 days per thousand man-hours. Another quarry, operated regularly for some years by the same company, had 7 temporary total injuries in a worktime of 248,000 man-hours during the year. The frequency at this quarry was 28 injuries per million man-hours or about one third that at the reopened quarry. The severity rate of 0.8 at the second quarry was about 40 per cent lower than at the reopened operation.

Hazards to New Employees

Are inexperienced men more susceptible to certain hazards around an operation? Analysis of the injury reports shows a high proportion of injuries to inexperienced men in the following causes: Dropping object being handled, fall from an elevation and falls on same level, hand tools, lifting or straining, and

while operating or riding haulage equipment. This does not prove that inexperienced men are more susceptible to these hazards. Analysis of the injury reports indicates that the inexperienced men apparently have not had enough training in safe work practices, as there is implied unfamiliarity with surroundings and implied awkwardness or clumsiness in many of the injury reports. For example, in lifting or straining injuries, one third of the total were to men with less than 1 year of experience. Similarly, in injuries caused by an object being dropped while it was being handled, one third of the total number from this cause were to inexperienced men. Injuries from both these causes, combined with inexperience, certainly point to lack of training in how to do a job safely.

Unfamiliarity with surroundings and with safe job methods can be implied from two injuries to truck drivers, each of whom stepped on a loose stone when

Injury—Frequency Rates at Quarries and Nonmetal Mines in the United States, 1939-48, by Type of Material ¹

Year	Cement		Limestone		Lime		Marble		Granite	
	Fatal	Nonfatal	Fatal	Nonfatal	Fatal	Nonfatal	Fatal	Nonfatal	Fatal	Nonfatal
1939	0.23	8.79	0.39	48.77	0.34	49.25	—	60.91	0.56	42.42
1940	.27	9.44	.56	52.54	.53	47.07	.50	40.32	.98	44.26
1941	.22	10.93	.64	55.96	.67	61.30	—	46.33	.55	49.40
1942	.65	11.07	.58	48.98	.47	52.35	.45	38.55	1.12	42.39
1943	.35	12.99	.69	42.96	.59	50.33	—	37.04	.52	41.94
1944	.33	13.92	.77	42.21	.63	47.00	.30	30.68	.67	43.00
1945	.19	12.48	.68	39.25	.41	48.99	.53	43.24	.81	45.97
1946	.19	12.99	.62	44.86	.19	48.94	—	32.68	.46	45.11
1947	.37	11.59	.54	43.45	.28	47.16	.29	29.27	.33	54.32
1948	.32	10.64	.64	39.52	.38	41.97	.17	31.36	.43	36.21

Year	Traprock		Slate		Sandstone		Nonmetal mines		Total	
	Fatal	Nonfatal	Fatal	Nonfatal	Fatal	Nonfatal	Fatal	Nonfatal	Fatal	Nonfatal
1939	0.95	65.00	0.56	70.42	—	65.31	0.58	41.61	0.36	36.76
1940	.70	62.94	.20	70.83	1.02	50.80	.74	43.50	.52	36.18
1941	.76	68.31	.18	57.21	.34	59.76	.73	50.89	.47	41.00
1942	.89	59.43	.45	74.44	.19	59.49	.80	51.07	.64	37.04
1943	.93	58.98	—	50.07	.82	56.82	.89	52.54	.57	36.39
1944	.77	58.58	1.26	61.17	.41	60.54	.66	49.81	.58	36.89
1945	—	47.15	—	49.97	.55	56.73	.65	46.52	.45	34.69
1946	.59	43.12	.60	54.35	.42	48.44	.97	50.94	.44	35.09
1947	.59	51.37	.66	53.36	.97	53.09	.42	45.40	.43	33.86
1948	.20	51.08	.61	39.88	.13	42.77	.53	41.09	.42	25.58

¹ Data for 1948 are preliminary

getting out of their trucks and sprained an ankle and a knee. Another truck driver was walking over loose stones on the quarry floor and slipped and fell. The total time lost from the three injuries was 95 days. None of these drivers had more than 9 months experience. You might say that these men had not yet developed a sixth sense which would tell them whether or not a loose rock would turn before they stepped on it. However, in each case, the safety engineer said that the men were told not to step on or walk on loose stones. Apparently the only way to avoid injuries from loose stones is not to walk on them.

In another injury case, a mucker with 2 months experience in a nonmetal mine was riding on the step of the mine locomotive when his foot was caught between the step and a pile of ties alongside the track. Not only was poor housekeeping involved by not providing proper clearance but also the safety engineer could ask, "Why was the mucker riding on the locomotive step?"

A typical example of insufficient training of new employees was the 7-day injury to a wagon-drill helper with 1 month experience. The employee used a Stillson wrench to tighten a nut, and the wrench slipped. He just didn't know the proper tool to use for the job.

As was stated earlier, the problem of transforming the new and inexperienced employee into a safe working employee is a difficult one. It can be solved only at the plant level, because it is only at that point that the full scope and aggressiveness of a training program are known.

Most Frequent Causes Also Have High Severity

Causes of injuries were stated on 425 of the 477 injury reports received from the quarries and non-metal mines enrolled in the 1948 National Safety Competition. Classification of the reports with known causes shows a total of 64 per cent from the following 5 causes: Struck by falling object or material not being handled by the injured and falls of persons, each of which caused 16 per cent; haulage and machinery, each of which caused 11 per cent; and lifting and straining, which caused 10 per cent of the injuries. These causes were not only the most numerous but they also resulted in injuries with the greatest average severity.

Falling Material

The hazards of falling material not being handled by the injured caused 3 fatalities, 6 permanent partial,

and 59 temporary total injuries. The temporary total injuries had an average severity of 52 days. Falls or slides of rock from the face or roof are included in this group, and this hazard caused more than half of the injuries in the group. As would be expected, a large proportion of the injuries from falls or slides of rock resulted from not scaling or testing the face or roof before starting the loading or drilling operation. A number of men were injured by falls during scaling operation when the injured men either took an unsafe position or were using improper tools for scaling or testing. Then, there was the jackhammer man who was drilling with his back to the quarry face when a 500-pound rock fell from the face and struck his leg. There were also several injuries to workmen who were struck by small stones from the face and were injured because they were not wearing hard hats.

Falls of Persons

Falls of persons also resulted in high severity injuries. There were 1 fatal and 69 temporary total disabilities from this cause. The average severity of the temporary injuries was 36 days. Falls from elevations caused 30 of these injuries, and the remaining 40 resulted from falls on the same level. Ladders, improper guarding of platforms or other elevated places, and poor construction of platforms were prominent in the chain of events leading to a fall from an elevation. An electrician who was working on a platform repairing a cable pulled on the cable, which broke, the recoil caused him to lose his balance and fall 20 ft. to the ground. The platform was not guarded on all sides, the superintendent of the operation said on the report that future accidents of this sort would be prevented because the railing was now built on all sides. Poor equipment also causes falls of persons as in the case of a repairman who was repairing a broken tramway cable. The injured man was standing on the ground pulling broken tramway cable together with rope blocks when the rope broke, and he was thrown to the ground. The time loss for this accident was 132 days.

Haulage

Haulage accidents, the third most frequent cause of injuries in quarries and nonmetal mines, caused 2 fatal, 4 permanent partial, and 42 temporary total injuries. The temporary injuries had an average disability of 35 days. One third of the haulage accidents were those in which the injured person was struck by or squeezed between the haulage equip-

ment or between the equipment and the sides. One nonmetal mine had 2 identical haulage injuries in which each employee had his fingers caught between a car and a post owing to the insufficient clearance. The remaining haulage injuries in this study were from a variety of causes, although injuries while re-railing haulage equipment and while dropping railroad cars were not uncommon in occurrence. In 1948 haulage injuries while coupling and uncoupling cars were not important in number, whereas in a similar study of 1947 accidents, coupling and uncoupling injuries were fairly numerous.

Machinery

Machinery accidents resulted in 2 fatal, 8 permanent partial, and 37 temporary total injuries. The average disability per temporary injury was 21 days. More than half of the injuries from this hazard involved drilling machinery. Finger and toe injuries were fairly common around drills. Also several accidents were noted in which the hose connection to the drill burst and the air hose flew around hitting the driller. In accidents involving the heavier types of machinery, lack of coordination in signalling and also disregard of basic safety rules were noted. In one case, a laborer with 3 months experience was helping to repair a break on a conveyor belt near screens. The belt was started while the man was still on it, and he was thrown on the screen. The report stated that the belt controls should have been locked out while the men were working on the belt. In another instance, a Joy loader helper was helping repair the machine. His fellow worker did not understand his signal, and the helper's fingers were caught between the chain and the sprocket. The safety engineer says that better coordination between the workers and closer attention to the signals would have avoided the accident. A fatal injury occurred when a scaler's head was caught between the scaling cage and roof. The cage had a 42-in. guard rail on all sides. The report was not clear whether the cage was being raised or if the scaling machine and cage were being moved laterally. The safety engineer says the accident could have been avoided by having the machine move more slowly.

Lifting and Straining

Lifting and straining accidents resulted in 1 permanent partial and 42 temporary total injuries. The temporary injuries had an average disability of 21 days. In most cases lifting and straining injuries re-

sulted when the injured took an unsafe position in lifting or tried to move too great a load. This is not always true, as in the case of the wagon-drill helper who was tightening the bit on the well drill, using an extension pipe. He suffered concussion of the shoulders and lost 29 days. The safety engineer says shoulder pads should have been provided.

Caution

Group injury experience of a number of quarries and nonmetal mines has been analyzed in an attempt to point out accident elements which should warrant special attention from both frequency and severity viewpoints. Although any one element may not have caused an injury in a particular quarry for some years, it is an element that is always present in the operation and therefore is something that should be avoided.

Farm Bureau Calls For State-Wide Safety Programs

THE American Farm Bureau Federation, at its annual meeting in Chicago recently, adopted a resolution urging "active participation by State Farm Bureaus in state-wide accident prevention programs," and commending state and county bureaus "for promoting safe-driving contests and other activities designed to enhance traffic safety."

Citing the importance of farm-to-market roads to farm family living standards, the Federation reaffirmed its support for federal-aid. "We will continue our efforts to secure better rural roads. We insist that a fair share of monies appropriated for public roads be used in the improvement of rural roads."

Most Stock Via Roads

ALMOST two-thirds of all the cattle, hogs and sheep marketed last year arrived by truck, according to Corn Belt Farm Dailies. The nearly 10 million tons of livestock delivered by truck accounted for 68 per cent of total tonnage. Without the motor truck, the publications said, the livestock industry "could not possibly operate at its present capacity."

James M. Rice Joins NCSA Staff



THE National Crushed Stone Association announces with pleasure the addition of James M. Rice to the engineering staff. Mr. Rice, who, as Testing and Research Engineer, has assumed the duties formerly performed by J. E. Gray and later by Phillip C. Clarke, accepted the position July 1, 1949, with a varied and interesting background in the engineering field.

Graduating from Purdue University with a Bachelor of Science Degree in Public Service Engineering in 1940, Mr. Rice spent the war years in the Southwest Pacific area. During his four years with the U. S. Army Signal Corps he attained the rank of Captain and was awarded the Bronze Star for meritorious achievement for his part in the Luzon Campaign while serving with the Sixth Army.

After his return to the United States and civil life, Mr. Rice began working towards his Master's Degree in Civil Engineering and studying highway engineering under the well-known Professor Kenneth B. Woods at Purdue University. Under Professor Woods, he became graduate research assistant on the Joint Highway Research Project. During this time he was also on the teaching staff of the School of Civil Engineering in the Materials Testing Laboratory. His thesis, "Suitability of Indiana Dune, Lake and Waste Sands for Bituminous Pavements," was presented in collaboration with Professor W. H. Goetz at the 1949 Annual Meeting of The Association of Asphalt Paving Technologists and appears in Volume 18 of the proceedings of that association.

During the interval between his army and academic careers were laboratory and research positions with the Walter H. Flood Testing Laboratories in Chicago, Illinois, and with K. E. McConaughay in Lafayette, Indiana. With the Flood Laboratories he held the position of Laboratory Assistant and Asphalt Plant Inspector, a position which exercised his knowledge of materials testing. With the McConaughay organization he specialized in research on the stability and adhesion of asphalt emulsion pavement mixtures.

Mr. Rice, whose home is Cleveland Heights, Ohio, is presently a member of the U. S. Corps of Engineers Reserves, a junior member of The American Society of Civil Engineers, an associate member of the Highway Research Board, and a registered professional engineer.

Value of "Pumping" Brakes on Icy Roads

WINTER, with icy roads and early darkness, is the peak period for traffic accidents. It calls for lower speeds and extra care in driving.

To learn more about the way motor vehicles behave on icy surfaces, the University of Wisconsin Engineering College experiment station made a series of driving tests last winter on a frozen lake near Clintonville, Wis.

The study revealed two facts that can help motorists in driving on icy roads.

One is that friction between tires and icy roads is highest at the moment brakes are applied—but if the brakes are held down, so the wheels start skidding, friction drops sharply and doesn't improve until the car is finally sliding very slowly.

This means, the research engineers point out, that brakes should be "pumped" gently to stop the car on icy roads. For emergency stops, pumping should be rapid.

The second fact shown by the study was that motorists seeking to get out of a slippery place should not race the engine and spin the wheels.

Once the wheels start spinning, the engineers found they lose almost all ability to move the car. But if the driver can start slowly, and keep the wheels from spinning, friction between tires and icy road surfaces is much greater.

When temperatures drop below freezing, the study showed the pulling power of tires on ice also drops.

Other winter driving studies show that by rounding slippery curves under slight power from the engine, motorists can help avoid side skids.—"Automobile Facts."

Status and Relative Progress of the Federal-Aid Highway Program¹

By THOS. H. MacDONALD

Commissioner of Public Roads
Bureau of Public Roads
U. S. Department of Commerce
Washington, D. C.

SINCE 1940,—one year less than a full decade,—our highways have been confronted with all the vicissitudes that conceivably could fall to their lot. A review of the pertinent facts confirms the magnificent record of performance of the state highway departments. There is no denial of the accomplishments under difficulties of the local highway officials, urban and rural, but the problem of keeping the highways in service under the rapidly growing number and the over-weight concentration of motor vehicles has been most acute on the state and interstate routes. That the major highway network has been kept in operation under the adverse conditions is proof positive of the effective organization of the highway departments, and particularly of their maintenance abilities. Perhaps the job of keeping these major highways operating is now being too well done. During the war period it was the only possible course. Now the highway officials know the extent to which a very large proportion of the most important routes are kept in service only on borrowed time, and that the cost is eating extravagantly into construction funds seriously needed to rebuild them into safe, efficient facilities.

In this period—1940 to 1949—the over-all increases and changes in the factors that reflect both the quantity and character of the services demanded from our highways are not only very large; they are also growing more adverse in their relative proportions.

The number of registered motor vehicles increased from 32,452,861 in 1940 to 41,151,326 in 1948,—about 27 per cent as a total.

The number of busses increased from 62,582 in 1940 to 135,430 in 1948,—about 116 per cent.

The number of trucks, including tractor trucks, increased from 4,590,366 in 1940 to 7,227,380,—about 57 per cent.

The preliminary estimates for 1949 indicate a further increase of about 6.6 per cent in motor vehicles over 1948,—a total of 43 million plus.

The estimated vehicle-miles of service provided by our highways in 1940 was 302,143 millions, and in 1948—397,589 millions,—an increase of above 30 per cent.

Thousands of miles of highways have deteriorated beyond a reasonable condition for use, and thousands of miles more reach this condition annually. Based on experience records in 35 states it is estimated that in the neighborhood of 40,000 miles of the federal-aid systems alone should be replaced each year.

The structural deterioration is being hastened and in addition an ever-increasing mileage is rapidly becoming deficient in width, sight distance, strength and other features because of the enormous increase in volume and weight of traffic. For trucks only, the vehicle-miles traveled in 1948 on the same roads was 9 per cent greater than in 1941 and 24 per cent greater than in 1936. The ton-miles of truck loads carried in 1948 was 42 per cent higher than in 1941 and 197 per cent higher than in 1936. The average load carried by trucks in 1948 was 38 per cent higher than in 1941 and 73 per cent higher than in 1936. The frequency of heavy axle loadings has also increased tremendously. Axle loads of 18,000 lb. were found on an average of 13 out of every 1,000 vehicles on the highways in 1936 and on 93 out of every 1,000 vehicles in 1948, a 615 per cent increase. Axle loads of 22,000 lb. or more were found on an average of 2 vehicles per thousand in 1936 and 20 per thousand in 1948, a tenfold increase.

Progress of the Federal-Aid Construction Program

Against these service requirements and indicated potentials must be measured the progress in highway improvement. Taken by itself the federal-aid operations of the latest fiscal year are encouraging, but relative to needs the whole program of construction and maintenance is inadequate and unbalanced.

The total of almost 21,000 miles completed last year represents an increase of about 3,000 miles over the mileage completed during the prior fiscal year. About 18,000 miles were completed during the fiscal year 1948, 8,000 miles during 1947, and 3,000 miles during 1946.

The 21,000 miles of federal-aid highways opened to traffic during the fiscal year ended last June 30

¹ Presented at the 35th Annual Meeting of the American Association of State Highway Officials, San Antonio, Texas, October 11, 1949.

included the construction or major reconstruction of almost 3,000 bridges over streams, railway-highway or highway-grade separations and combinations. A total of 149 railway-highway grade crossings were eliminated during the year, and protective devices were installed at an additional 466 grade crossings.

The improvements are classified as follows: about 1,900 miles of bituminous, portland cement concrete or other high type surfaces; 8,400 miles of intermediate bituminous types—surface treatments or mixed bituminous surfaces; 7,400 miles of non-dustless type—selected soil, gravel or stone; and about 1,900 miles of grading and drainage, in preparation for future surfacing.

The influence of the secondary road program is reflected in the types of improvements. The relatively large proportion of intermediate and low types reflects the pressures for the rehabilitation of long mileages.

During the four years since the end of the war, there has been completed and opened to traffic a total of nearly 50,000 miles of federal-aid highways. Another 19,000 miles are under construction or covered by approved plans, and an additional 15,000 miles are programmed for construction. These figures constitute an enviable record, particularly in view of the many difficulties that have confronted the highway construction industry in this postwar period.

The total cost of projects completed during the past year was almost \$750,000,000, of which about \$390,000,000 were federal funds. In dollar volume the work completed last year set a new record high for the 33-year history of federal aid.

Construction Put in Place

The record for construction put in place during the past year, including work done on projects not yet completed, is even more encouraging.

The value of work done during the year is estimated at \$826,000,000, of which about \$421,000,000 are federal funds. These totals represent an increase of nearly 25 per cent over the value of work done during the prior year. Thus, in the construction phase of the program, we are approaching the \$450,000,000 annual rate of federal fund authorizations provided by the Federal-Aid Highway Act of 1948 for the fiscal years 1950 and 1951.

For the present calendar year the value of construction to be put in place is estimated at about \$850,000,000 total cost. Even when adjustments are made for the lesser purchasing power of the dollar

today as compared to the 1930's, this figure represents a volume of federal-aid work to be done this year that is greater than that of any prior year.

Although the construction phase of the program is approaching the annual rate of federal fund authorizations on a country-wide basis, there is still a relatively large number of states that are far from reaching this objective. Last year the value of work done in 24 of the states was approximately equal to or more than the state's proportionate share of a \$450,000,000 federal authorization. In eight states the work done corresponded to an authorization rate between about \$400,000,000 and \$450,000,000. In 19 states the corresponding rate was less than \$400,000,000 and it is in this latter group particularly that special attention needs to be given to further advancement of the program to a rate consistent with federal authorizations, as soon as it is possible to do so. (The above counts include the District of Columbia, Hawaii and Puerto Rico.)

Comparison of the Calendar Years 1948 and 1949

Contracts awarded on federal-aid projects during the first eight months of the calendar year 1948 totaled about \$497,000,000. During the corresponding period this year the total was approximately \$448,000,000, representing a decrease from last year of almost \$49,000,000 or about 10 per cent. Awards during August of this year were almost 22 per cent less than during August a year ago.

In advancing projects through plans approved stage, the net total this past year amounted to about \$358,000,000, measured in federal funds. During the previous year the corresponding total was \$452,000,000. Thus the total this year, again expressed in federal funds, was \$94,000,000 or about 20 per cent less than during the year prior, and amounted to only about 82 per cent of an apportionment of \$450,000,000.

The same trend is indicated in programming activities. Projects programmed this past year amounted to \$810,000,000 in total cost and \$403,000,000 in federal funds, representing a decrease of 21 per cent from the previous year.

Federal-aid funds authorized for the fiscal year 1951 were apportioned recently and made available to the states effective October 1, 1949 to assist those states whose program is advanced well beyond the average.

In addition to the 1951 funds, there was an unprogrammed balance of more than \$200,000,000 in postwar funds available on September 1, 1949. Also,

programmed projects financed from postwar funds for which contracts were not awarded on September 1, amounted approximately to a \$450,000,000 apportionment.

Primary Roads

Of the three classes of highways provided for by the postwar legislation, the program financed from primary funds is further advanced. Nearly 15,000 miles have been completed and opened to traffic, and about 2,450 bridges have been built. The value of construction put in place, expressed in federal funds, is equal to the full amount of the apportionments for the first two postwar fiscal years plus about one-third of the apportionment for the third year. About 93 per cent of the total postwar primary funds available prior to the recent apportionment of 1951 funds has been programmed.

Secondary Roads

The program financed from secondary funds is nearly as far along. The nearly 30,000 miles completed is about double that for the primary program, and over 3,300 new bridges are now in use on secondary roads. The federal fund value of construction put in place is somewhat greater than the apportionments for the first two postwar fiscal years.

Urban Highways

The urban program has not kept pace with the primary and secondary programs. Projects completed to date account for less than the first postwar fiscal year apportionment of urban funds. Although 80 per cent of the urban funds apportioned for the fiscal years 1946, 1947, 1948, and 1950 have been programmed, less than 60 per cent have been covered by approved plans.

Interstate System Improvements

Interstate system improvements to July first of this year accounted for about 30 per cent of the total amounts programmed for these two classes of funds combined. About 23 per cent of the primary funds and nearly 46 per cent of the urban funds are for interstate system improvements.

The federal funds programmed for interstate system improvements amounted to about \$345,000,000 for 3,700 miles of construction, for which the estimated total cost was \$690,000,000. The rate at which interstate system improvements have been programmed during the postwar period thus amounts to about 1,000 miles annually.

By way of comparison with this actual progress, the report "Highway Needs of the National Defense"

indicates that a capital investment averaging probably more than \$500,000,000 annually will be required for the next 20 years if the system is to be brought to a state of adequacy during this longest reasonable period.

Joint Economic Committee Survey

The Joint Economic Committee of the Congress in July of this year requested the Governor and highway officials of each state to submit to the Committee a report of highway deficiencies in their states. A report prepared under direction of the Committee indicates that 44 states estimate their highway deficiencies to be in excess of \$29,000,000,000.

Certainly the backlog of needed road construction is tremendous. It follows that the federal-aid program should now proceed at the maximum rate possible.

Some of the Conditions Affecting Highway Improvement Progress

The estimated dollar value of federal-aid construction work actually put in place in the calendar year 1948 is \$768,400,000, which is 8.3 times the corresponding figure of \$92,900,000 for 1945. Adjusting both amounts by means of our composite mile price index to eliminate the effect of inflation, we find that the physical volume of work performed in 1948 is 5.8 times as great as in 1945. This extraordinary progress was achieved despite the tremendous obstacles to be overcome.

In the last quarter of 1948 bid prices were 48 per cent above the average for the calendar year 1945 and 123-1/2 per cent above the average for the calendar year 1940. The extremely high prices were the result of numerous unfavorable conditions.

Most of the materials and equipment items essential to highway construction were in critically short supply and many months were required to effect delivery. Costs rose accordingly as exemplified by the following figures:*

Item	1940 Price	1948 Price	Per cent Increase
2 x 4 in. Fir lumber per M.b.m.	\$34.88	\$97.28	179
2 x 4 in. Pine lumber per M.b.m.	31.15	88.41	184
Reinforcing steel per cwt.	2.43	4.58	88
Structural steel per cwt.	3.44	4.90	42
Cement per bbl.	2.51	3.82	52
Paving asphalt in cars, per ton	15.12	24.17	60
Gravel per ton	1.47	2.15	46
Sand per ton	1.17	1.96	68
Gasoline per gallon	0.184	0.265	41
1-1/2 to 2-ton dump trucks	852.00	1,447.00	70
Tractor (100 H.P. and over)	7,300.00	12,650.00	74

* Based on Engineering-News-Record data and reports available in Public Roads.

Even when materials and equipment could be obtained delivery was frequently delayed from several months to a year or more.

Labor shortages were encountered generally throughout the country, particularly in the skilled classifications. Often such labor as was available was inexperienced, with consequent low productivity. Average hourly wage rates had increased from \$0.64 in 1940 to \$1.40 in 1948, or 119 per cent.

In 1947 it appeared that it might not be possible to increase the size of the construction program because of lack of capacity of the contracting industry to handle additional work. This was based on reports from all parts of the country that contractors were overloaded with work and were unable to maintain satisfactory progress on their contracts, and on the fact that an average of only 3.8 bids were being received per project advertised, with no bids at all received on many projects.

Uncertainties regarding future economic conditions, cost trends and availability of materials, labor and equipment caused contractors to protect themselves by including in their bids a considerable allowance for contingencies.

In addition to all these difficulties many states found themselves lacking sufficient competent engineers to make surveys, prepare plans and supervise the construction. A few states were handicapped to some extent because of financial difficulties but most of them had ample funds available as a result of large surpluses accumulated during the war years.

As we entered the 1949 construction season the situation had changed greatly. Materials and equipment were in general readily available in adequate quantities although spot shortages of steel and cement are still being reported occasionally. The labor supply was much improved in both quality and quantity. Workmen more experienced, more energetic and more dependable could be obtained. Instead of being troubled with a shortage of labor we are now being asked to expedite highway construction work in certain areas where unemployment threatens to become a serious problem.

Economic conditions have been stabilized to the extent that contractors need no longer cushion their bids because of the uncertainties with which they were formerly plagued regarding the future costs and working conditions. The contractors have become better organized and equipped. Since the beginning of 1948 federal-aid contracts have been awarded to 841 contractors who had not had any such contracts during the postwar period. In addition

to these 841 new contractors entering the highway field, several hundred other new ones have bid on one or more contracts without being successful in obtaining a contract. As a result there has been a marked increase in competition. Instead of the 1947 average of 3.8 bids per project the average for the first six months of 1949 was 5.9 bids per project which is an increase of 55 per cent. Rarely do we now hear of an overloaded contractor and it seems obvious that the contracting industry now has more than sufficient capacity to handle the contemplated programs.

As a consequence of these improved conditions bid prices decreased steadily during the first six months of this year. By the end of the second quarter of 1949 the composite mile price index of the Bureau of Public Roads showed a drop of six per cent from the peak in the fourth quarter of 1948 when it was 123-1/2 per cent above the 1940 figure.

In about a third of the states the slow progress is due wholly or partly to a continuing shortage of engineers. Intensive recruiting and training programs coupled with recently authorized salary increases and other benefits have brought about some improvement in the situation in many states. However, most of the additional engineers being attracted to the highway departments are recent college graduates with little or no practical experience. It takes considerable time for these men to develop into fully qualified design and construction engineers. As a result there is still a definite shortage of higher grade engineers, especially those with ability to handle structural designs and the complicated problems involved in urban projects. The engineering situation is gradually improving and lack of engineers should soon cease to be a major impediment to construction progress except in those states which do not increase the salary scale and other employee benefits sufficiently to attract and hold the quality and number of men they need.

The Question of Highway Funds

An important deterrent to progress this year has undoubtedly been the inability of some of the states to provide matching funds for the available federal funds. The surpluses accumulated during the war years were exhausted and current revenues were not sufficient to meet the demands. In a number of states where state funds are ample the counties and cities are required by law or policy to supply the matching money or to provide the rights-of-way for

secondary and urban projects, respectively, and frequently there is serious delay.

Although highway construction costs increased 123-1/2 per cent from 1940 to 1948 and the federal-aid highway funds available annually now are more than twice what they were in the prewar years, the increase in state and local revenues available for highway purposes has not kept pace over the nation as a whole and in some states has been considerably less. The total state funds available to the 48 states and the District of Columbia for state highway purposes were \$862,839,000 in 1940 and \$1,599,359,000 in 1948, an increase of only 85 per cent. The corresponding amounts available for local roads and streets were \$331,516,000 in 1940 and \$621,527,000 in 1948, an increase of 87 per cent. In each year a substantial portion of the state funds was required for service of state obligations, for state highway police and for administration, maintenance and non-federal-aid construction in which federal funds did not participate.

The figures given for revenues and expenditures are for the nation as a whole. In individual states the situation varies over a wide range. In five states the current revenues available for administration, construction and maintenance were from two to three times as great in 1948 as in 1940, in two states they were nearly four times as great. On the other hand, in two states the current revenues for the same purposes were actually less in 1948 than in 1940, in one state 14 per cent less and in the other five per cent less. Fortunately the recent legislatures in both of these states took action to remedy the situation so that adequate matching funds are now available. In some of the other states, however, where similar action was needed none was taken, and the highway departments are still faced with the problem of trying to finance highway improvements at postwar prices with little more than prewar incomes. In three states where the legislatures enacted tax increases to provide additional highway funds attempts have been made to repeal the legislation by referendum vote.

The Tyranny of Rising Maintenance Costs

Because of the cessation in highway construction during the war years and the increase in both volume and weight of traffic since then, the federal-aid highway system has been wearing out or becoming obsolete at a much faster rate than reconstruction has been performed and permanent improvements made. This has resulted in extremely heavy main-

tenance costs and has necessitated recourse to low type reconstruction and improvements as temporary expedients to keep traffic moving. As federal funds cannot be used for maintenance, the abnormally large expenditures have caused further disparity between the federal-aid funds available and the state matching funds available for new construction and reconstruction on fully adequate standards. The temporary expedients used have merely postponed, rather than eliminated, the day when highway income and highway construction costs must be brought into closer agreement if serious breakdowns in our major highway systems are to be avoided.

It is a good example of living in a "fool's paradise" to substitute costly maintenance for needed capital improvements. There is no escape from the payment for our highways whether or not we have them.

To illustrate, in a state with limited gas tax revenue, where every federal-aid matching dollar is needed, state highway maintenance expenditures rose from 2.1 to 4.8 million dollars per year—from \$387 to \$795 per mile. While the cause must be assigned partly to a rise in price level, examination of the highway systems discloses the existence of sections with 3/4-in. bituminous mats on a weak base costing from \$1,183 to \$1,641 per mile for surface maintenance. Highway users were frequently required to ride over these rough surfaces and spring load limits prohibited the realization of full benefits from the motor vehicle investment.

Reports from a second state indicate that it is becoming increasingly difficult for the maintenance forces to do other repair than the roadway surfacing. Forty-nine per cent of 1935 maintenance expenditures was for the surface; in 1940 it was 58 per cent; and in 1948 it was 73 per cent. This mounting work increases pressure for inroads into funds that would be available for matching the state's share of federal-aid construction costs.

A third state reported that out of 2,812 miles of bituminous roads, 65 per cent are inadequate for maintenance and out of 1,430 miles of rigid pavements, 40 per cent are inadequate for maintenance. The roads require strengthening of base, resurfacing and improvement of structures. The maintenance budget in this state was further stressed by the Western snow disaster. The 11-year average snow removal cost was increased 300 per cent.

A fourth more populated state reports maintenance forces struggling with repairs on a state highway system that has a narrow right-of-way and

drainage problems on 3,100 miles of road. There are 1,165 miles of rural and 138 miles of urban pavement that are in need of widening, and 1,378 miles in need of additional shoulder width; 1,089 bridges (including grade separation) should be replaced, and 266 should be widened. It is anticipated that 10,895 miles of rural highways and 712 miles of urban highways in this state will need resurfacing in the next 11 years. This same state in 1943 observed that out of 2,953 miles of concrete pavements 243 miles, or eight per cent, developed symptoms of pumping. By 1948 road pumping spread to 1,590 miles or 40 per cent of the concrete roads on the state system.

In summary, we might be tempted to become complacent because of the very considerable dimensions of the current construction program. But an honest evaluation of the rate of highway improvement compared with the necessities can leave only one conclusion—that we are seriously losing in the battle with traffic.

The only possible attack upon our current highway problems that has any hope of bringing relief must be the application of the successful, and the discard of the unsuccessful policies out of our usable past.

Among the problems which are demanding priority of consideration is the inadequacy of current revenues. We cannot provide for the traffic in expanded quantities and increasing weights in the postwar period with prewar revenues. We cannot solve our most serious traffic problems by toll roads. The very fact that the worst congestion occurs within the metropolitan areas rules out the toll road because of its operating characteristics. Further, the financing of roads with revenue bonds is an expensive expedient. Toll roads financed with revenue bonds should not be confused with roads supported by faith and credit of the public. The difference in cost between revenue bonds and faith and credit bonds will be sufficient to amortize the cost of the road in a 30- to 40-year period. There is too much confusion of terms. Roads financed with bonds do not need to be revenue bond toll roads. Any road that should be built with bond proceeds because of traffic volume pressures for better facilities will be self-supporting if the road user tax earned by the road when built is dedicated to bond retirement, and the bonds are issued at the low interest the states can now command. We know from our records that we obtained the most rapid extension of the first

systems of modern roads now in service in many states by bond issues which have been comfortably carried by a fraction of the expanding revenues, and there is no valid reason now why this process cannot be repeated where necessary.

Again out of our usable past we know that it is the pattern of administration and organization at state and national levels that has produced the roads we now use and kept them in operation under adverse conditions. In a troubled world we need internal peace, and we cannot achieve this in our over-all road program until the pattern of operations adjusted to the needs, that has been developed and proven satisfactory for state operations, is extended to the local roads. This problem will remain with us and will grow more acute until roads are provided adequate for the operation of motor vehicles to serve the rural districts.

Finally, the most important problem of all at state, federal or local level, is a larger force of trained engineers and technicians who know they have a stable career in the highway improvement field. More adequate salaries, opportunities for advancement through in-training courses, retirement plans, are among the necessities to attract men to highway work.

The group here represented is responsible for a major element in our nation's economy. Highway problems are not static, and a successful attack upon them must be dynamic.

ALI Releases New Promotional Folder

THE Agricultural Limestone Institute has just announced release of a new promotional folder entitled "Limestone, Organic Matter, and Nitrogen."

This new folder tells the story of the importance of organic matter and nitrogen and the reason why soils must be limed if the supply of these life-giving soil constituents is to be maintained. Together they are the foundation on which the superstructure of good farming is erected. This folder will help make and keep farmers conscious of the importance of liming.

For further information about this folder and other helpful material write to the Agricultural Limestone Institute, 1415 Elliot Place, N.W., Washington 7, D. C.

Manufacturers Division—National Crushed Stone Association

These associate members are morally and financially aiding the Association in its efforts to protect and advance the interests of the crushed stone industry. Please give them favorable consideration whenever possible.

Allis-Chalmers Mfg. Co.

Milwaukee 1, Wis.
Crushing, Screening, Washing, Grinding, Cement Machinery; Motors; Texrope Drives; Centrifugal Pumps; Tractors

American Cyanamid Co.

Explosives Department
2527 Oliver Bldg., Pittsburgh 22, Pa.
Explosives and Blasting Supplies

American Manganese Steel Division of

American Brake Shoe Co.

389 East 14th St., Chicago Heights, Ill.
Manganese Steel Castings, Power Shovel Dippers, Material Handling Pumps, Heat and Corrosion Resistant Castings, Reclamation and Hard-Facing Welding Materials

American Pulverizer Co.

1249 Macklind Ave., St. Louis 10, Mo.
Manufacturers of Ring Crushers and Hammermills for Primary and Secondary Crushing

American Steel & Wire Co.

Rockefeller Bldg., Cleveland 13, Ohio
Wire Rope, Aerial Wire Rope Tramways, Electrical Wires and Cables, Welded Wire Fabric, Concrete Reinforcing, Wire Nails, Fencing, Netting

Atlas Powder Co.

Wilmington 99, Del.
Industrial Explosives and Blasting Supplies

Austin-Western Co.

601 N. Farnsworth Ave., Aurora 1, Ill.
Jaw and Roll Crushers, Conveyors, Feeders, Screens, and Bins—Separately or Combined in Complete Crushing, Screening and Washing Plants; All Types of Dump, Hopper, and Quarry Cars, Air and Electrically Operated, in Narrow and Standard Gauges; Power Shovels, Drag Lines, and Cranes; Road Making, Earth Handling, and Street Cleaning Equipment

Bacon-Greene & Milroy

205 Church St., New Haven 10, Conn.
"FARREL-BACON" Jaw Crushers for Primary and Secondary Operations, Conveyors, Elevators, Rolls, Screens

Bacon-Pietsch Co., Inc.

149 Broadway, New York 6, N. Y.
Manufacturers of Farrel-Bacon Crushers and Allied Screening and Conveying Equipment

Barber-Greene Co.

Aurora, Ill.
Portable and Permanent Belt Conveyors, Belt Conveyor Idlers, Bucket Loaders both Wheel and Crawler Mounted, Asphalt Mixers and Finishers, Coal Handling Machines

C. G. Buchanan Crushing Machinery Division of the Birdsboro Steel Foundry and Machine Co.

1941 Furnace St., Birdsboro, Pa.
Primary, Secondary, and Finishing Crushers and Rolls

Bucyrus-Erie Co.

South Milwaukee, Wis.
Excavating, Drilling and Material Handling Equipment

Caterpillar Tractor Co.

Peoria 8, Ill.
Track-Type Tractors, Bulldozers, Earth-moving Scrapers, Motor Graders, Heavy-Duty Off-Road Hauling Units, Diesel Engines, and Diesel Electric Generating Sets

Cross Engineering Co.

Carbondale, Pa.
Screen Plates and Sections, Perforated Plate for Vibrating, Rotary and Shaking Screens

Cummins Engine Co., Inc.

Columbus, Ind.
Diesel Engines, Fuel Pumps

Deister Machine Co.

1933 East Wayne St., Fort Wayne 4, Ind.
Deister Plat-O Vibrating Screen, Deister Compound Funnel Classifier

Detroit Diesel Engine Division

General Motors Corp.

13400 West Outer Drive, Detroit 23, Mich.
Light Weight, Compact 2 Cycle Diesel Engines and "Package Power" Units for All Classes of Service

E. I. du Pont de Nemours & Co., Inc.

Wilmington 98, Del.
Explosives and Blasting Accessories

Eagle Iron Works

129 Holcomb Ave., Des Moines, Iowa
Fine Material Screw Washers—Classifiers—Dehydrators; Coarse Material Screw and Log Washers—Dewaterers; Water Scalping and Fine Material Settling Tanks; and "Swintek" Screen Chain Cutter Dredging Ladders

Easton Car and Construction Co.

Easton, Pa.
Heavy-Duty Dump Body Trailers for Rock and Ore, Truck Bodies, and Quarry Cars; Overhead Hoists for Dumping Haulage Units; Electric Heaters for Tar, Asphalt or Bitumen

Ensign-Bickford Co.

Simsbury, Conn.
Primacord-Bickford Detonating Fuse and Safety Fuse

Manufacturers Division—National Crushed Stone Association (continued)

Euclid Road Machinery Co.

1361 Chardon Road, Cleveland 17, Ohio
Heavy-Duty Trucks and Dump Trailers for
"Off-Highway" Hauls, Loaders for Earth
Excavation

Flexible Steel Lacing Co.

4607 Lexington St., Chicago 44, Ill.
Flexco HD Belt Fasteners, Alligator Belt
Lacing, Flexco Hinged Belt Fasteners,
Alligator Belt Cutters, Alligator Wide
Belt Cutters, Alligator V Belt Fasteners,
Flex V Belt Fasteners

Frog. Switch & Mfg. Co.

Carlisle, Pa.
Manganese Steel Department—Manufactur-
ers of "Indian Brand" Manganese Steel
Castings for Frogs, Switches, and Cross-
ings, Jaw and Gyratory Crushers, Cement
Mills, Mining Machinery, Etc., Steam
Shovel Parts

General Electric Co.

1 River Road, Schenectady 5, N. Y.
Electric Motors, Controls, Locomotives, Co-
ordinated Electric Drives for: Shovels,
Drag Lines, Conveyors, Hoists, Cranes,
Crushers, Screens, Etc.; Coordinated Power
Generating and Distributing Systems In-
cluding Turbine Generators, Switchgear,
Transformers, Cable, Cable Skids, Load
Center Substations

Gill Rock Drill Co.

Lebanon, Pa.
Well Drill Tools and Supplies

Goodyear Tire & Rubber Co., Inc.

Akron 16, Ohio
Airfoam; Mechanical Goods—Belting (Con-
veyor, Elevator, Transmission), Hose (Air
Water, Steam, Suction, Miscellaneous),
Chute Lining (Rubber); Rims (Truck and
Tractor); Storage Batteries (Automobile,
Truck, Tractor); Tires (Automobile,
Truck, Off-the-Road); Tubes (Automobile,
Truck, Off-the-Road, LifeGuard,
Safety Tubes, Puncture Seal Tubes

Gruendler Crusher and Pulverizer Co.

2915 N. Market St., St. Louis 6, Mo.
Rock and Gravel Crushing and Screening
Plants, Jaw Crushers, Roll Crushers,
Hammermills, Lime Pulverizers

George Haiss Mfg. Co., Inc., Division of Pettibone Mulliken Corp.

141st-144th on Park Ave., New York 51,
N. Y.
Bucket Loaders, Buckets, Portable and Sta-
tionary Conveyors, Car Unloaders

Harnischfeger Corp.

4400 W. National Ave., Milwaukee 14, Wis.
A complete line of Power Excavating
Equipment, Overhead Cranes, Hoists,
Smootharc Welders, Welding Rod, Motors
and Generators

HarriSteel Products Co.

420 Lexington Ave., New York 17, N. Y.
Wovex Wire Screen Cloth

Hayward Co.

50 Church Street, New York 7, N. Y.
Orange Peel Buckets, Clam Shell Buckets,
Electric Motor Buckets, Automatic Take-
up Reels

E. Lee Heidenreich, Jr., Consulting Engineers

67 Second St., Newburgh, N. Y.
Plant Layout, Design, Supervision; Open Pit
Quarry Surveys; Appraisals—Plant and
Property

Hendrick Mfg. Co.

Carbondale, Pa.
Perforated Metal Screens, Perforated Plates
for Vibrating, Shaking, and Revolving
Screens; Elevator Buckets; Test Screens;
Wedge Slot Screens; Open Steel Floor
Grating

Hercules Powder Co.

Wilmington 99, Del.
Explosives and Blasting Supplies

Hetherington & Berner Inc.

701-745 Kentucky Ave., Indianapolis 7, Ind.
Asphalt Paving Machinery, Sand and Stone
Dryers, Dust Collectors

Highway Equipment Co., Inc.

616 D Ave., N. W., Cedar Rapids, Iowa
Complete Line of Spreaders

Illinois Powder Mfg. Co.

112 N. 4th St., St. Louis 2, Mo.
Gold Medal Explosives

Ingersoll-Rand Co.

11 Broadway, New York 4, N. Y.
Rock Drills, Quarrymaster Drills, Jackbits,
Bit Reconditioning Equipment, Portable
and Stationary Air Compressors, Air
Hoists, Slusher Hoists, Air Tools, Diesel
Engines, Pumps

Insley Manufacturing Corp.

801 N. Olney St., Indianapolis 6, Ind.
Concrete Carts and Buckets, ½ Yd. Cranes
and Shovels

Iowa Manufacturing Co.

Cedar Rapids, Iowa
Rock and Gravel Crushing, Screening, Con-
veying and Washing Plants, Hot and Cold
Mix Asphalt Plants, Stabilizer Plants, KU-
BIT Impact Breakers, Screens, Elevators,
Conveyors, Portable and Stationary Equip-
ment, Hammermills

Jeffrey Manufacturing Co.

E. First Ave., Columbus 16, Ohio
Material Handling Machinery, Crushers,
Pulverizers, Screens, Chains

Manufacturers Division—National Crushed Stone Association (continued)

Joy Manufacturing Co.

333 Oliver Bldg., Pittsburgh 22, Pa.
Drills: Blast-Hole, Wagon, Rock, and Core;
Air Compressors: Portable, Stationary,
and Semi-Portable; Aftercoolers; Port-
able Blowers; Carpullers; Hoists; Multi-
Purpose and Portable Rock Loaders; Air
Motors; Trench Diggers; Belt Conveyors;
Drill-Bit Furnaces; "Spaders"; "String-a-
Lite" (Safety-Lighting-Cable); Backfill
Tampers; Drill Bits: Rock and Core

Kennedy-Van Saun Mfg. and Eng. Corp.

2 Park Ave., New York 16, N. Y.
Material Handling Machinery—Crushers,
Pulverizers, Vibrating Screens

Kensington Steel Co.

505 Kensington Ave., Chicago 28, Ill.
Manganese Steel Castings, Dipper Teeth,
Crawler Treads, Jaw Plates, Concaves and
Hammers

Keystone Driller Co.

Beaver Falls, Pa.
Drills, Power Shovels

King Powder Co., Inc.

Cincinnati, Ohio
Detonite, Dynamites, and Blasting Supplies

Koehring Co.

3026 W. Concordia Ave., Milwaukee 10, Wis.
Mixers, Pavers, Shovels, Cranes, Draglines,
Dumtoms, Traildumps, Wind-Jacks

Kraft Bag Corp.

630 Fifth Ave., New York 20, N. Y.
Heavy Duty Multiwall Paper Bags

Lima Shovel and Crane Division

Lima-Hamilton Corp.

Lima, Ohio
Power Shovels, Draglines, and Cranes

Link-Belt Co.

300 West Pershing Road, Chicago 9, Ill.
Complete Stone Preparation Plants; Con-
veyors, Elevators, Screens, Washing
Equipment, Speed-O-Matic Shovels—
Cranes—Draglines and Power Transmis-
sion Equipment

Ludlow-Saylor Wire Co.

634 S. Newstead Ave., St. Louis 10, Mo.
Woven Wire Screens and Wire Cloth of
Super-Loy, Magna-Loy and All Commer-
cial Alloys and Metals

Mack Manufacturing Corp.

350 Fifth Ave., New York 1, N. Y.
On- and Off-Highway Trucks, Tractor
Trailers, Six-Wheelers, from 5 to 30 Tons
Capacity, both Gasoline- and Diesel-
Powered

Marion Power Shovel Co.

617 W. Center St., Marion, Ohio
A Complete Line of Power Shovels, Drag-
lines, and Cranes

McLanahan & Stone Corp.

200 Wall St., Hollidaysburg, Pa.
Complete Pit, Mine, and Quarry Equipment
—Crushers, Washers, Screens, Feeders, etc.

Murphy Diesel Co.

5317 W. Burnham St., Milwaukee 14, Wis.
Murphy Diesel Engines Ranging from 90 to
190 Continuous Horsepower at 1200 Rpm.
and Packaged Type Generator Sets 60 to
133 Kw. for All Classes of Service

N. P. Nelson Iron Works, Inc.

820 Bloomfield Ave., Clifton, N. J.
Nelson Bucket Loaders

New Holland Mfg. Co.

Division of New Holland Machine Co.

Mountville, Pa.
Double Impeller Impact Breakers—Station-
ary and Portable; Roll and Hammer
Crushers; Cinder Crushing Equipment;
Apron and Reciprocating Plate Feeders;
Bucket Elevators; Belt Conveyors; Vi-
brating Screens; Bins

Noble Co.

1860 7th St., Oakland 7, Calif.
Batching Plants, Bulk Cement Plants

Nordberg Mfg. Co.

307 S. Chase Ave., Milwaukee 7, Wis.
Cone, Gyratory, Jaw and Impact Crushers;
Grinding Mills; Stone Plant and Cement
Mill Machinery; Vibrating Screens; Griz-
zlies; Diesel and Steam Engines; Com-
pressors; Mine Hoists; Track Maintenance
Tools

Northern Blower Co.

W. 65th St., South of Denison
Cleveland 2, Ohio
Dust Collecting Systems, Fans—Exhaust and
Blower

Northwest Engineering Co.

135 S. LaSalle St., Chicago 3, Ill.
Shovels, Cranes, Draglines, Pullshovels

Osgood Co.

Marion, Ohio
Power Shovels, Cranes, Draglines, Hoes,
Etc., 3/8 to 2 1/2 Cu. Yd.

Pennsylvania Crusher Co.

Liberty Trust Bldg., Philadelphia 7, Pa.
Single Roll Crushers, Impactors, Hammer-
mills, Ring Type Granulators, KUE-KEN
Jaw Crushers, KUE-KEN Gyracones

Pioneer Engineering Works, Inc.

1515 Central Ave., Minneapolis 13, Minn.
Jaw and Roll Crushers, Vibrating and Re-
volving Screens, Scrubbers, Belt Convey-
ors, Traveling Grizzly Feeders

Manufacturers Division—National Crushed Stone Association (concluded)

Pit and Quarry Publications

538 South Clark St., Chicago 5, Ill.
*Pit and Quarry, Pit and Quarry Handbook,
Pit and Quarry Directory, Concrete Man-
ufacturer, Concrete Industries Yearbook*

Quaker Rubber Corp.

Tacony and Milnor Sts., Philadelphia 24, Pa.
Conveyor Belts, Hose, and Packings

Robins Conveyors Division.

Hewitt-Robins Incorporated

370 Lexington Ave., New York 17, N. Y.
*Belt Conveyors, Bucket Elevators, Gyrex
and Vibrex Screens, Feeders, Design and
Construction of Complete Plants*

Rock Bit Sales and Service Co.

350 Depot St., Asheville, N. C.
*Tungsten Carbide Detachable Bits, "Rock
Bit" Drill Steel Inlaid with Tungsten
Carbide, Carbon Hollow Drill Steel, Alloy
Hollow Drill Steel*

Rock Products

309 West Jackson Blvd., Chicago 6, Ill.

John A. Roebling's Sons Co.

Woven Wire Fabrics Division

Roebling, N. J.
*Aggregate Screen, Hardware and Industrial
Wire Cloth, Insect Screening, Wire Rope,
Fittings and Strand, Slings, Suspension
Bridges and Cables, Aerial Wire Rope
Systems, Ski Lifts, Electric Wire and
Cable, Magnet Wire*

Sanderson-Cyclone Drill Co.

South Main St., Orrville, Ohio
*All Steel Wire Line, Air Speed Spudders,
Large Blast Hole Drills, Drilling Tools
and Drilling Supplies*

Schild Bantam Co.

Waverly, Iowa
*Bantam Trench Hoes, Draglines, Clams,
Shovels*

Screen Equipment Co.

1754 Walden Ave., Buffalo 21, N. Y.
SECO Vibrating Screens

Simplicity Engineering Co.

Durand, Mich.
*Simplicity Gyrating Screen, Simplicity
D'centegrator, Simplicity D'watering
Wheel*

Smith Engineering Works

E. Capitol Drive at N. Holton Ave.
Milwaukee 12, Wis.
*Gyratory, Gyrasphere, Jaw and Roll Crush-
ers, Vibrating and Rotary Screens, Gravel
Washing and Sand Settling Equipment,
Elevators and Conveyors, Feeders, Bin
Gates, and Portable Crushing and Screen-
ing Plants*

St. Regis Sales Corp.

1925 O'Sullivan Bldg., Baltimore 2, Md.
Main Office: 230 Park Ave., New York 17,
N. Y.
*Automatic Filling and Weighing Machines
and Multiwall Paper Shipping Sacks*

Stedman's Foundry & Machine Works

Aurora, Ind.
*Stedman Impact-Type Selective Reduction
Crushers, 2-Stage Swing Hammer Lime-
stone Pulverizers*

Stephens-Adamson Mfg. Co.

Aurora, Ill.
*Belt Conveyors, Elevators, Feeders, Car Pull-
ers, Screens, Skip Hoists, Complete Plants*

Taggart Corp.

(See St. Regis Sales Corp.)

W. O. & M. W. Talcott, Inc.

91 Sabin St., Providence, R. I.
*Belt Fasteners, Belt Lacing, Conveyor Belt
Fasteners, and Patch Fasteners*

Taylor-Wharton Iron & Steel Co.

High Bridge, N. J.
*Manganese and Other Special Alloy Steel
Castings*

Thew Shovel Co.

Lorain, Ohio
*Power Shovels, Cranes, Crawler Cranes,
Locomotive Cranes, Draglines, Diesel
Electric, Gasoline, 3/8 to 2 1/2 Cu. Yd.
Capacities*

Torrington Co.

Bantam Bearings Division

3702 W. Sample St., South Bend 21, Ind.
*Anti-Friction Bearings (All Types and
Sizes)*

Traylor Engineering & Mfg. Co.

Allentown, Pa.
*Stone Crushing, Gravel, Lime, and Cement
Machinery*

Trojan Powder Co.

17 N. 7th St., Allentown, Pa.
Explosives and Blasting Supplies

W. S. Tyler Co.

3615 Superior Ave., N. E., Cleveland 14, Ohio
*Wire Screens, Screening Machinery, Scrub-
bers, Testing Sieves and Dryers*

Universal Engineering Corp.

625 C Ave., N. W., Cedar Rapids, Iowa.
*Jaw Crushers, Roll Crushers, Hammermills,
Complete Crushing, Screening, and Load-
ing Plants, Either Stationary or Portable
for Stone Aggregates or Aglime*

Vibration Measurement Engineers

7705 Sheridan Rd., Chicago 26, Ill.
*Specialists in Blasting Complaint Investiga-
tions; Seismological Surveying; Expert
Testimony in Blasting Litigation*

